Monday Afternoon, October 31, 2011

Energy Frontiers Focus Topic
Room: 104 - Session EN-MoA

Industrial Physics Forum on Energy II
Moderator: J.W. Rogers, Idaho National Laboratory, J.N. Hollenhorst, Agilent

2:00pm **EN-MoA1 The Role of Nuclear Energy in a Sustainable Energy Scenario**, ***H.F. McFarlane***, Idaho National Laboratory **INVITED**

Only three primary energy sources power the planet for humankind's benefit. Though seldom identified as such, the most familiar is nuclear fusion, which provides the solar flux to warm the earth, power the renewable wind and water cycles, and drive photosynthesis for plant growth. Ancient carbon bonds, formed over millions of years and stored in the form of familiar fossil fuels—oil, natural gas, and coal—comprise plentiful resources that enable most of our transportation and electricity generation. Uranium powers the third, and to many people the most mysterious, energy source, nuclear fission.

Different groups define sustainable energy in different ways, the specific definition usually crafted to advance a particular point of view. In this discussion, I shall use sustainable to mean that the resource and its application are sustainable for hundreds of years, through multiple generations. Five years ago who would have thought that we would be talking about a 100-year supply of affordable natural gas, yet that is what new technology may have brought us—though the environmental consequences are still being sorted out. Renewable energy will serve us as long as we have a clear view of the sun, or until the solar plasma reaches out and kisses earth. Nuclear energy brings emotional baggage. Nuclear energy's sustainability yardstick is multi-dimensional, not merely a question of how long uranium resources will last under various scenarios.

One well-accepted international research, demonstration and development program addresses nuclear sustainability at its core—the Generation-IV International Forum. From 200 candidate technologies, the Forum selected six advanced nuclear systems for possible development. Each system is required to set stretch goals for safety, nuclear proliferation resistance, economic competitiveness, and sustainability. That said, nuclear's sustainability relies on success in the first three goals as well as public acceptance.

This talk will use the Generation-IV framework applied to existing as well as future infrastructure. It will provide a provocative perspective on resources, safety (including the Fukushima-Daiichi accident resulting from an overwhelming tsunami), and nonproliferation. Nuclear energy's potential role in providing a significant fraction of electrical generation as well transportation fuels will be explored.

2:40pm **EN-MoA3 What's So Smart about the "Smart Grid?"**, ***J.G. Kassakian***, Massachusetts Institute of Technology **INVITED**

The "Smart Grid" has received considerable hype in Washington and the popular press. To some it means an automated metering infrastructure allowing consumers to participate in load management. To others it means the interconnection of distributed renewable resources and the introduction of electric vehicles. It is all of these and more. This presentation will provide an overview of the many dimensions of the smart grid vision, including anticipated technical innovations and policy changes necessary for realizing the vision.

3:40pm **EN-MoA6 Electrochemical Energy Storage for Renewable Integration and Grid Applications: Status, Challenges and Opportunities**, ***Z.G. Yang***, Pacific Northwest National Laboratory **INVITED**

Growing concerns over the environmental consequences of burning fossil fuels and their resource constrains, along with the increasing world energy consumption, have spurred great interests in renewable energy from sources such as wind and solar. However, the power from these intermittent sources is constantly varied, making quite challenging for its use and dispatch through the aging electrical grid. One effective way to smooth out the intermittency is to employ electrical energy storage (EES). As such EES has been widely considered as a key enabler of the future grid or smart grid that is expected to integrate a significant level of renewable, while providing electricity or "fuel" to hybrid and electrical vehicles. Among the potential technologies are electrochemical energy storage technologies or batteries that are capable of storing a large quantity of electricity and releasing it according to demands. There remain significant challenges however for the current technologies to meet the performance and cost matrices for broad market penetration. This paper offers an overview on varied technologies, in particular batteries, and discusses the status, challenges and research needs.

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